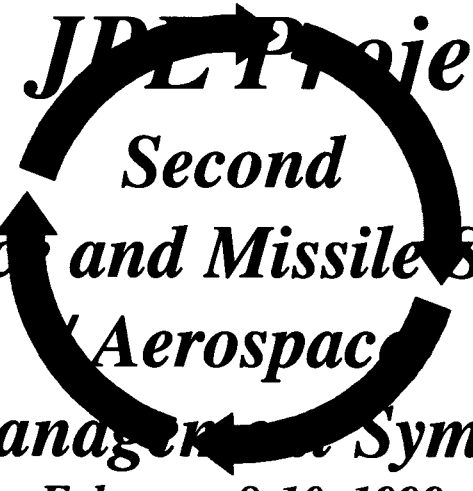
# *Risk Management (RM) on JPL Projects*

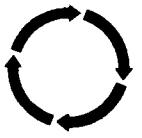


## *Second Air Force Space and Missile Systems Center / Aerospace Risk Management Symposium*

***February 8-10, 1999***

***Hyatt Regency Hotel, Long Beach California***

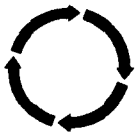
***Dr James Rose***



# Talk Outline

- **Objectives**
- **Introduction**
- **Process**
- **Methodology**
- **Tools**
- **Usage on Projects**
- **Lessons**
- **Status and Plans**

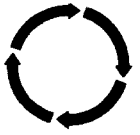
# *Risk Management on JPL Projects*
# Objectives



## Of This Talk

- **Participate in sharing experiences with Risk Managers in Aerospace Industry**

# *Risk Management on JPL Projects*
# Objectives

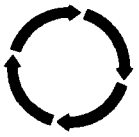


## Of Risk Management at JPL

- **Provide a RM process of real value to Project Management**
- **Establish RM on all Flight Projects**

**VISION**
**RM is enthusiastically adapted into the Projects' core management process BECAUSE IT WORKS!**

# *Risk Management on JPL Projects*



## Introduction

**Risk: -** The combination of the likelihood of occurrence and the severity of the consequences of the occurrence of an event (usually undesirable)

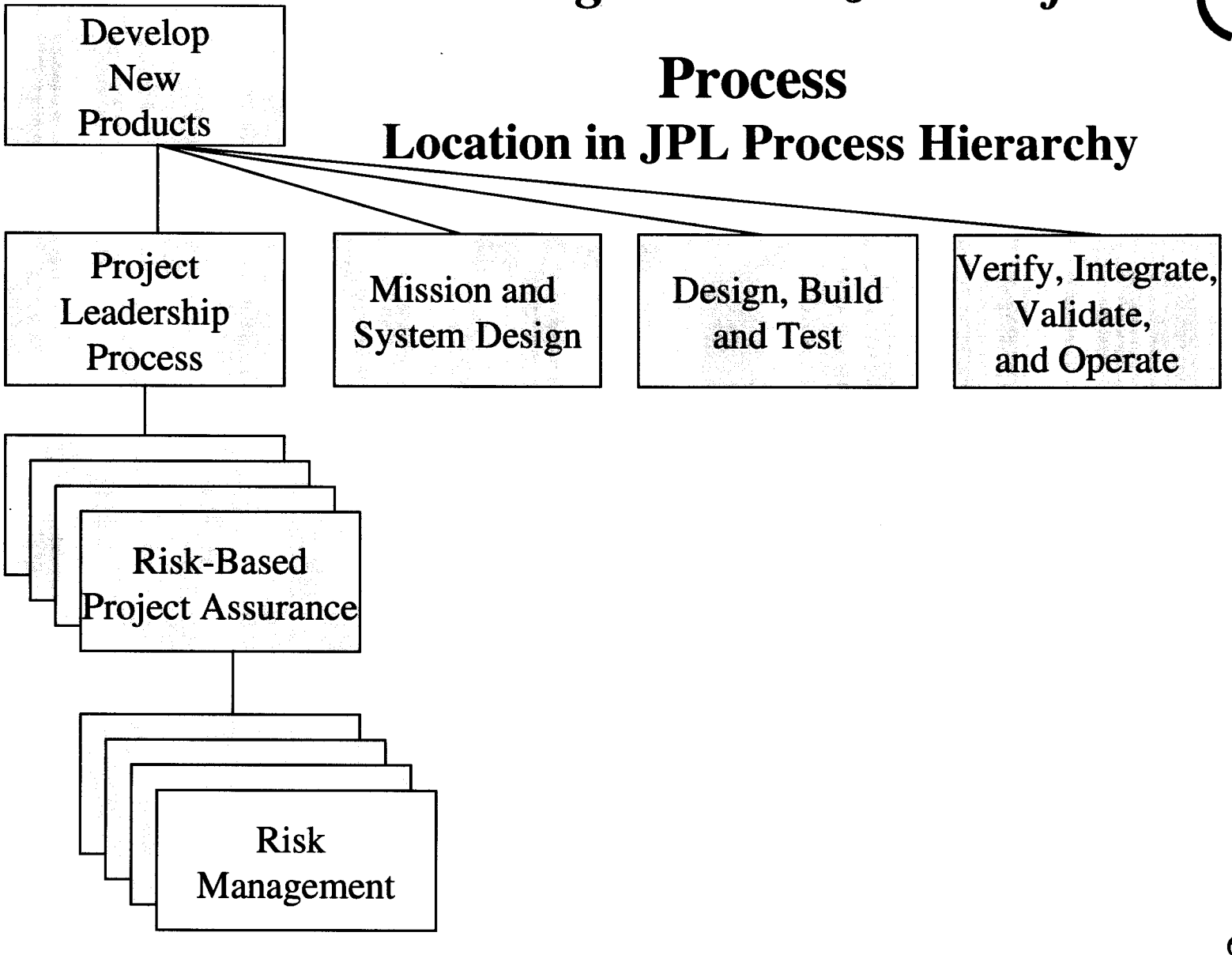
**Risk Management (RM):** An organized means of "controlling" the risk on a project

**RM Process:** -**Identification and assessment** of risk items,
-**Decision-making**,
-**Tracking** the resulting residual risks,
-**Planning** the activity

**RM at JPL:** Process Owner - Dr James Rose
MS 301-420, Ph 4-4491
Manager, Office of Reviews
and Risk management (517)
Office of Engineering and Mission Assurance

# *Risk Management on JPL Projects*

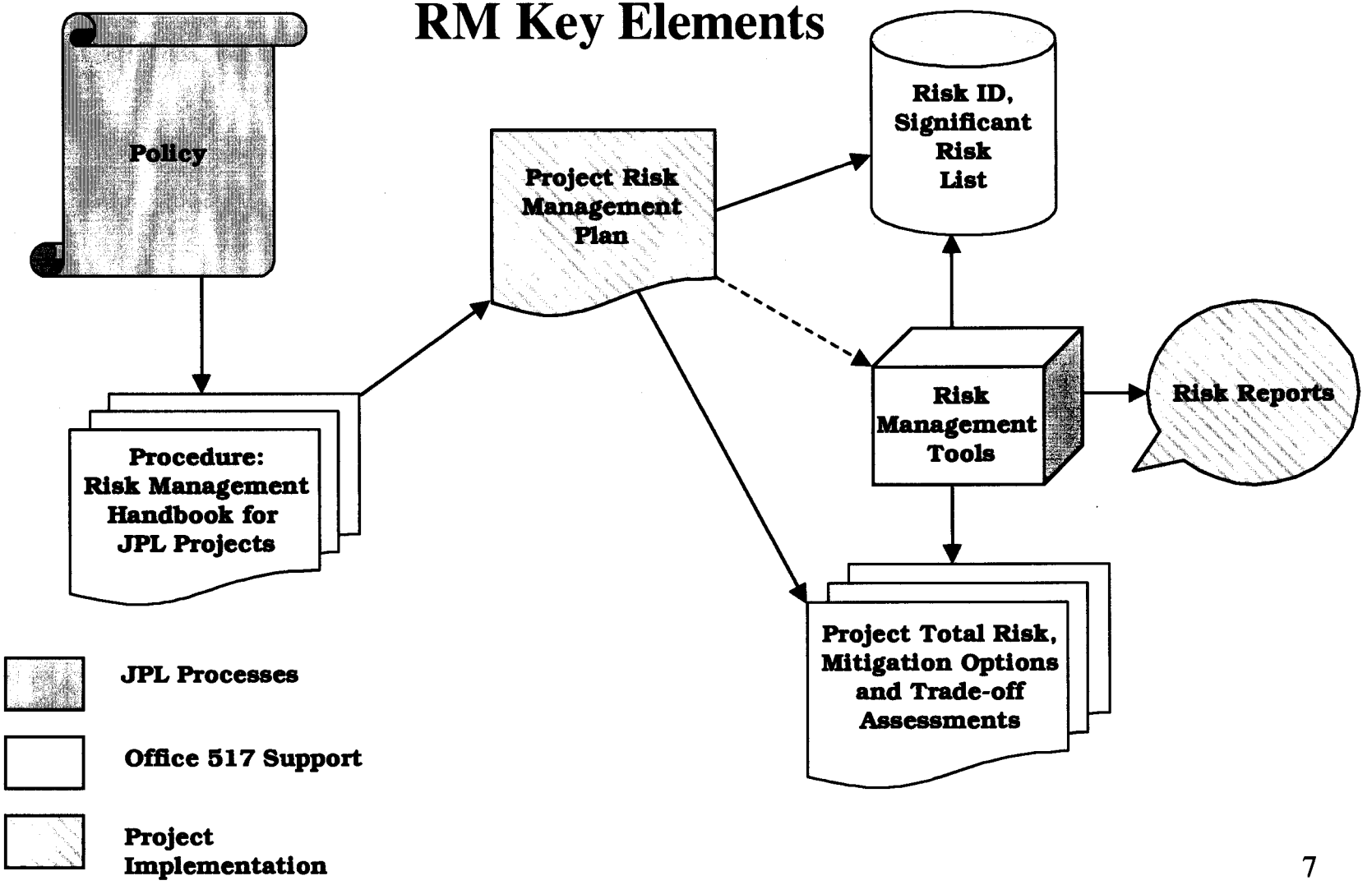
## Process
### Location in JPL Process Hierarchy



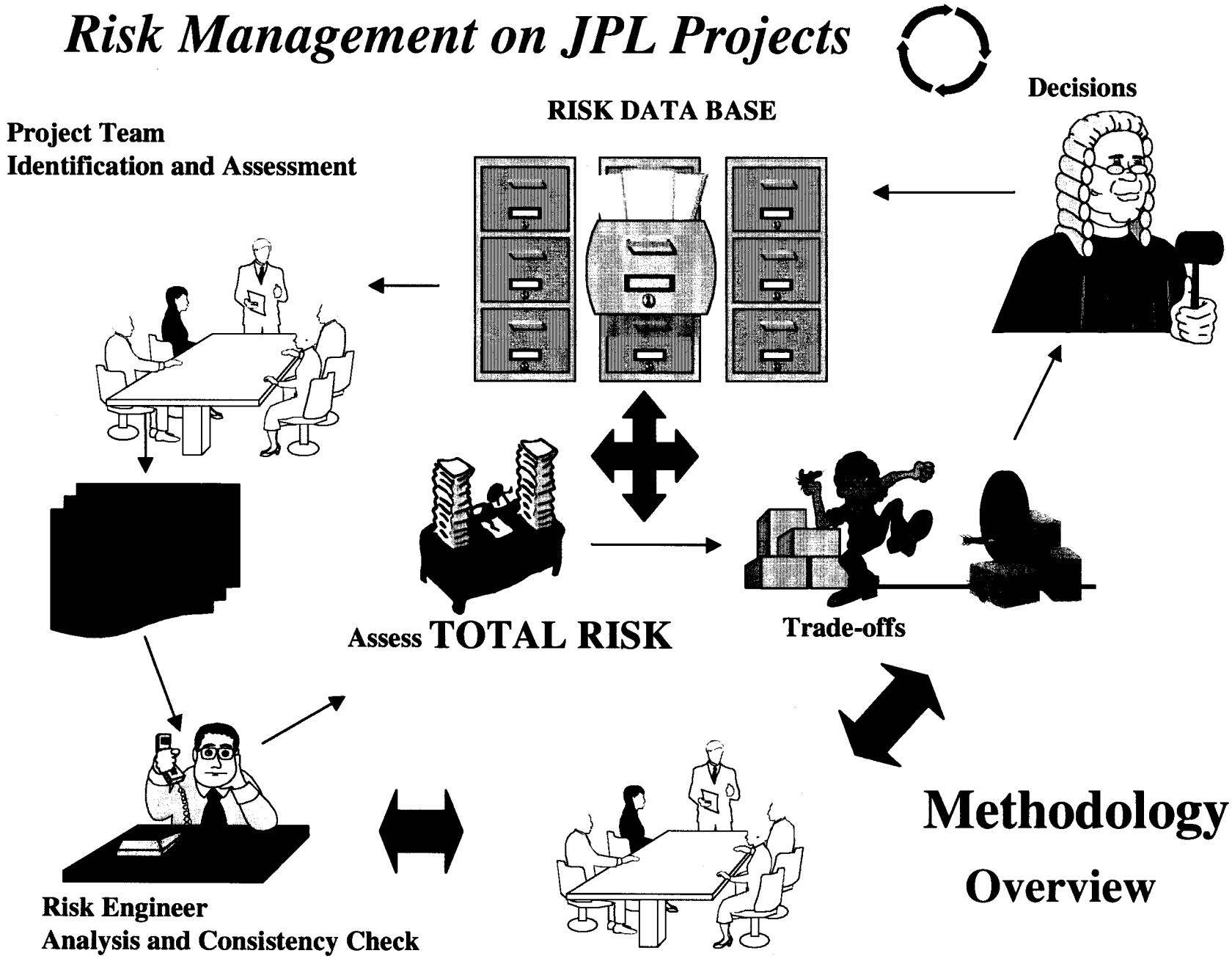
# *Risk Management on JPL Projects*

## Process

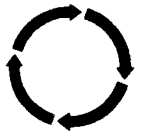
## RM Key Elements



# *Risk Management on JPL Projects*



# *Risk Management on JPL Projects*

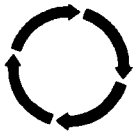


# Methodology

## Identification

- **Project Team Identifies and Assesses Risk Items**
  - Expert Judgment
  - Many sources - experience, analyses, lessons learned, project metrics etc.
  - Qualitative or Quantitative assessment
- **Two Aspects of Risk for Each Item**
  - Implementation Risk - what could happen and when that would cost $ to fix?
  - Mission Risk - if we can't/won't fix it, what impact on mission success?
- **Risk Item Characterized by**
  - Consequences and likelihood of occurrence
- **Other Data Identified**
  - Mitigation options and the change risk if an option is implemented

# *Risk Management on JPL Projects*



# Methodology

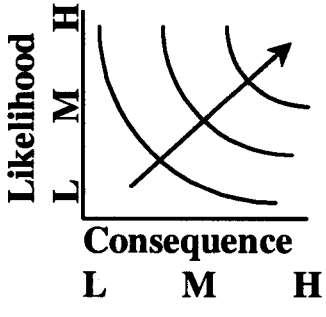
## Qualitative Assessment Approach

### Risk Item "i"

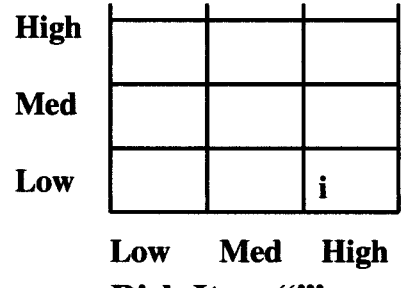
**Likelihood:** - Relative scale e.g. Low, Medium, High (from "no way" to "for sure")

**Consequence:** - Relative scale e.g. Low, Medium, High (from "no sweat" to "total disaster")

**Risk Measure:**

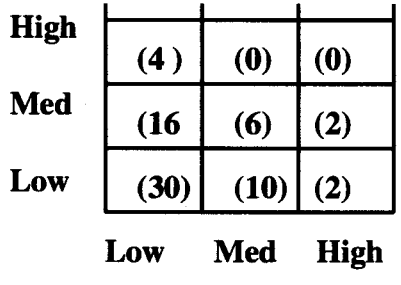



**Increasing Risk**




**Risk Item "i"**

## Project Total Risk Position:



# *Risk Management on JPL Projects*
# Methodology
## Quantitative Assessment Approach
### Risk Item "i"

**Likelihood:** - Measured from 0 to 1 (from "no way" to "for sure") - $\mathbf{p_i}$
**Consequence:** - Measured as a percentage of impact on Project Success Element k - $\mathbf{I_{ik}}$
**Project Success Elements:** - Needs to be chosen for each project
- Two standard success elements (metrics):
(1) - Implementation Risk ($)
(2) - Mission Risk (impact on mission success)

**Risk Measure:** - product of likelihood and consequence- $\mathbf{p_i x I_{ik}}$

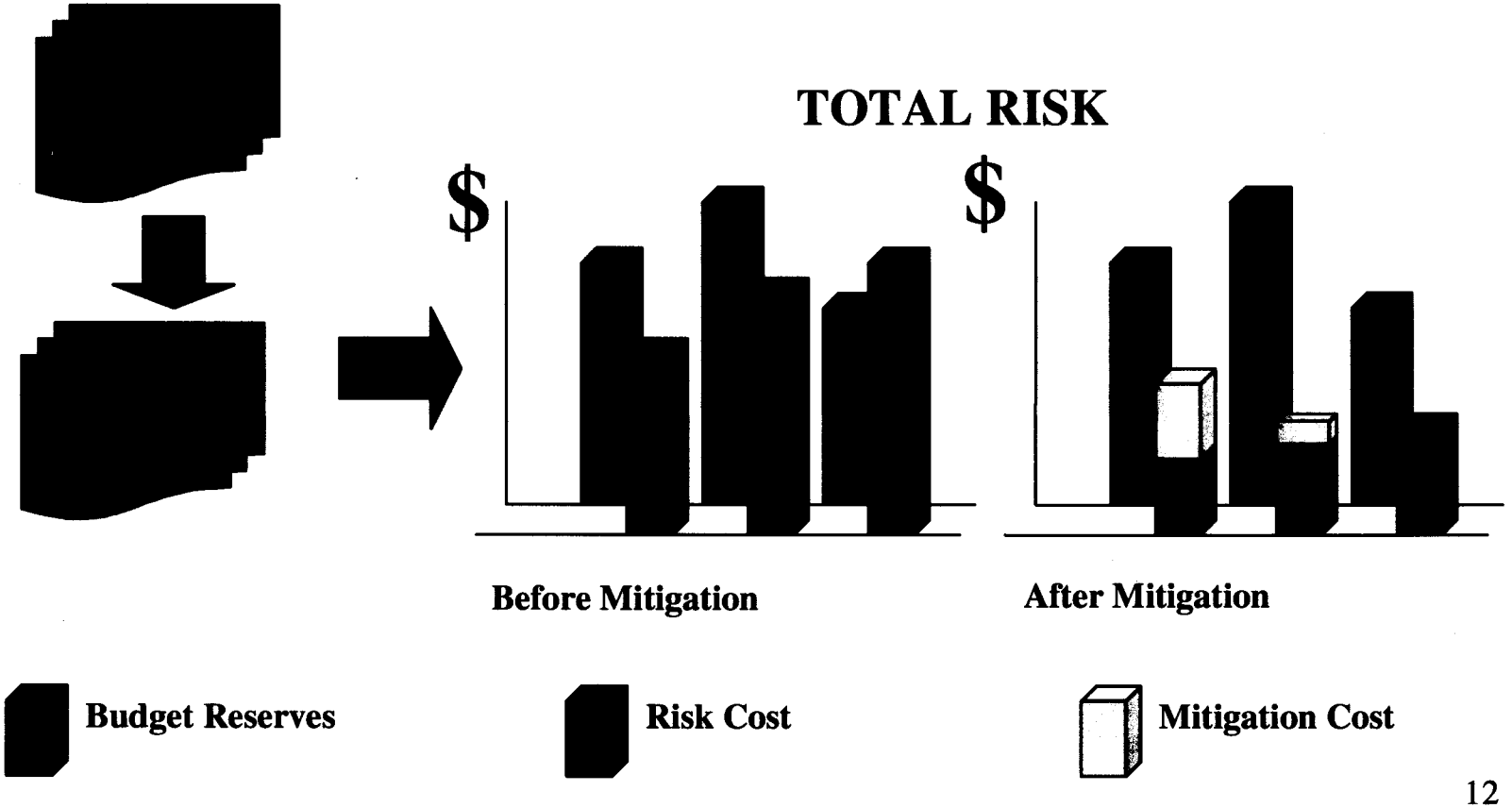
**Project Total Risk Position (R):** - For each consequence category (k),
Probabilistic sum of $\mathbf{p_i x I_{ik}}$ over (i)

(For most practical cases, can assume risks and consequences are independent and therefore
R=[sum over all i]$\mathbf{p_i x I_{ik}}$)

# *Risk Management on JPL Projects*

## Methodology

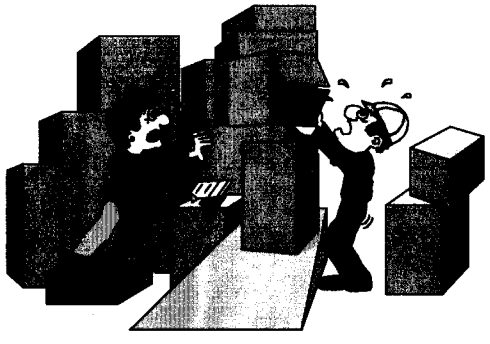
### Trade-offs and Decision-Making
### (Quantitative Implementation Risk Example)



# *Risk Management on JPL Projects*

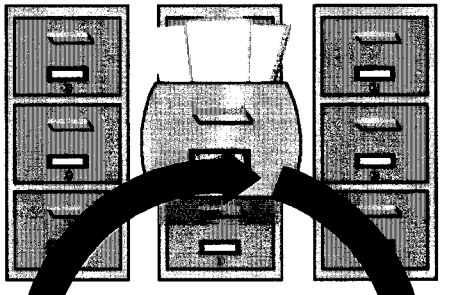
## Methodology

### Tracking

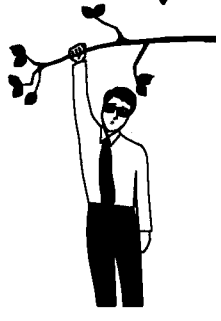


Project Life Cycle Proceeds

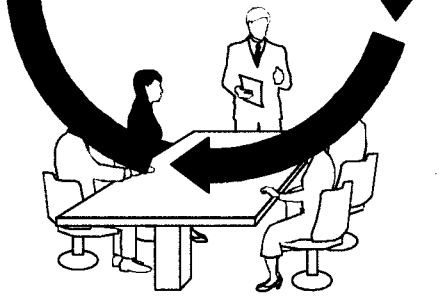
RISK DATA BASE



RISK METRICS



New and Changed Risks



Project Team

# *Risk Management on JPL Projects*
# Tools

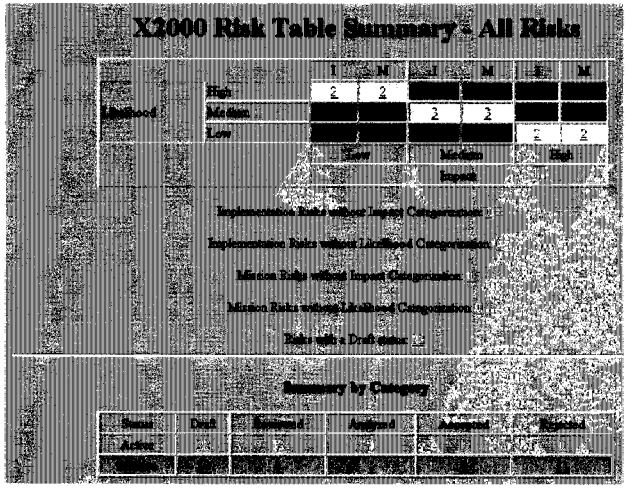
## Web-based Tailorable RM Tool

- A Risk Management data management tool available on the web to Project Team members
- Easily usable and tailorable
- Multi-user access
- Benefits:
  - Allows easy risk item data entry by all project team members
  - Provides Risk Engineer with data and status management capability
  - Provides configuration control

**X2000 Risk Management**

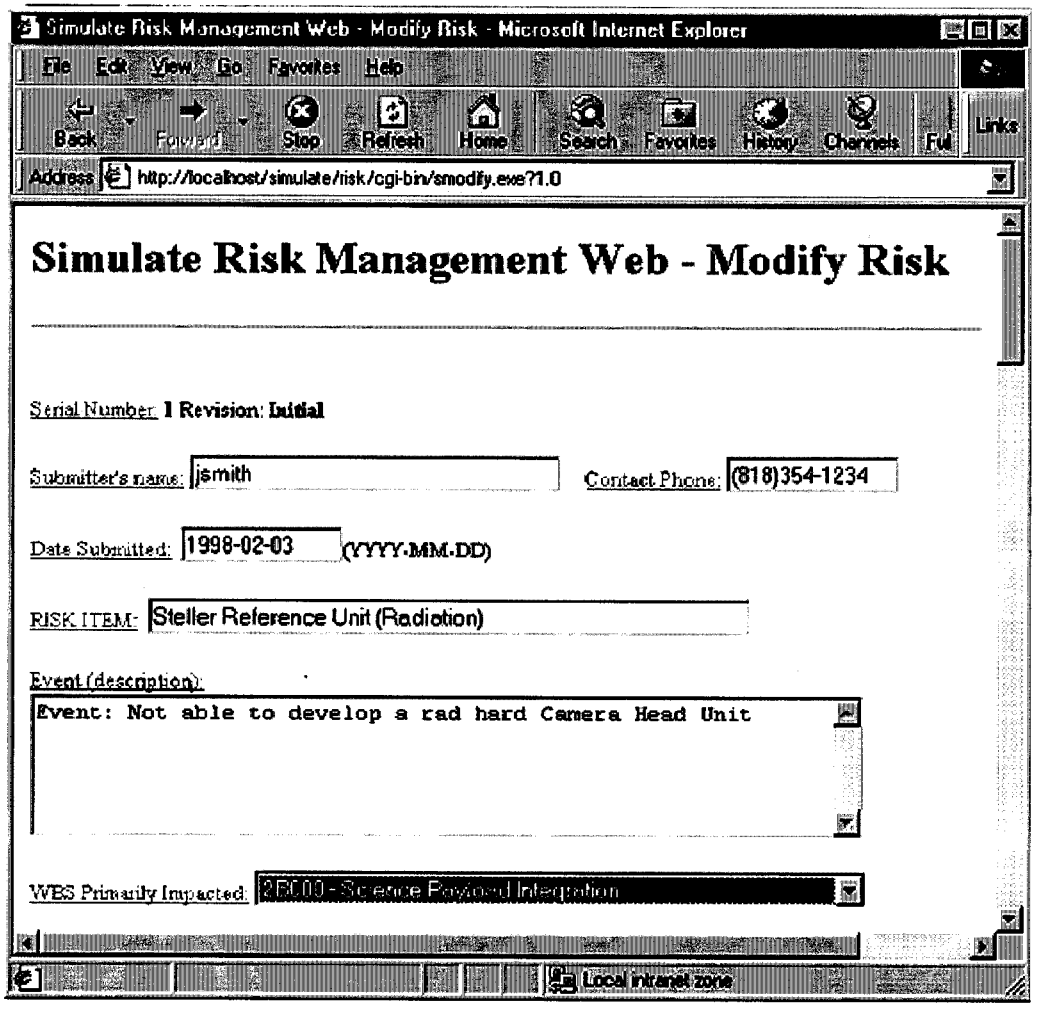
Welcome to the X2000 Risk Management System. If you would like to update a Risk item but are locked out, please
Ed Konefat 818-354-4125 or [redacted]

Add Risks
View/Modify Risks
View Risks Only
Risk Overall Summary
View Last Revision
JPL Risk Management



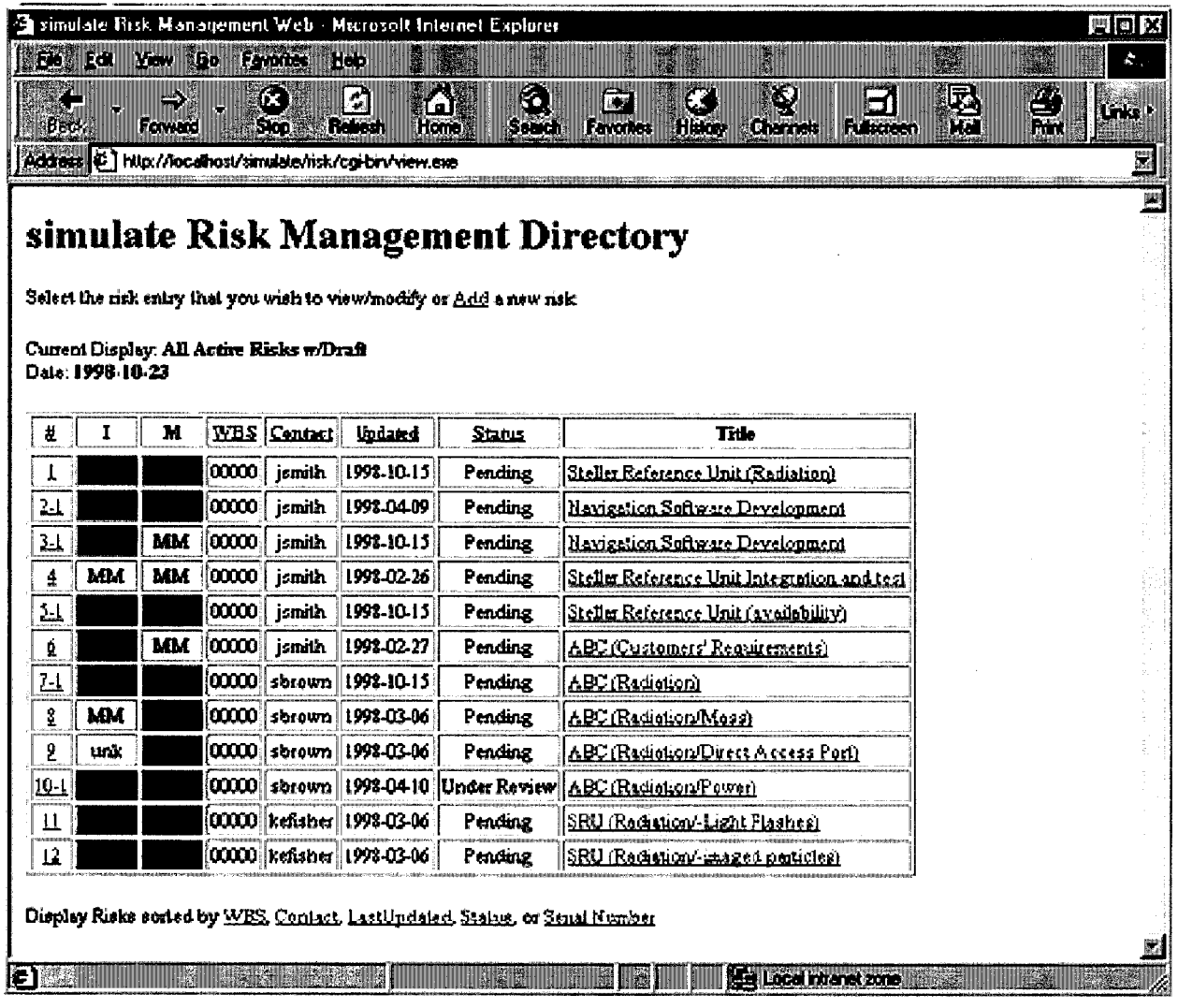
# *Risk Management on JPL Projects*

## Web-based Tailorable RM Tool
## Input Sheet (1)



# *Risk Management on JPL Projects*

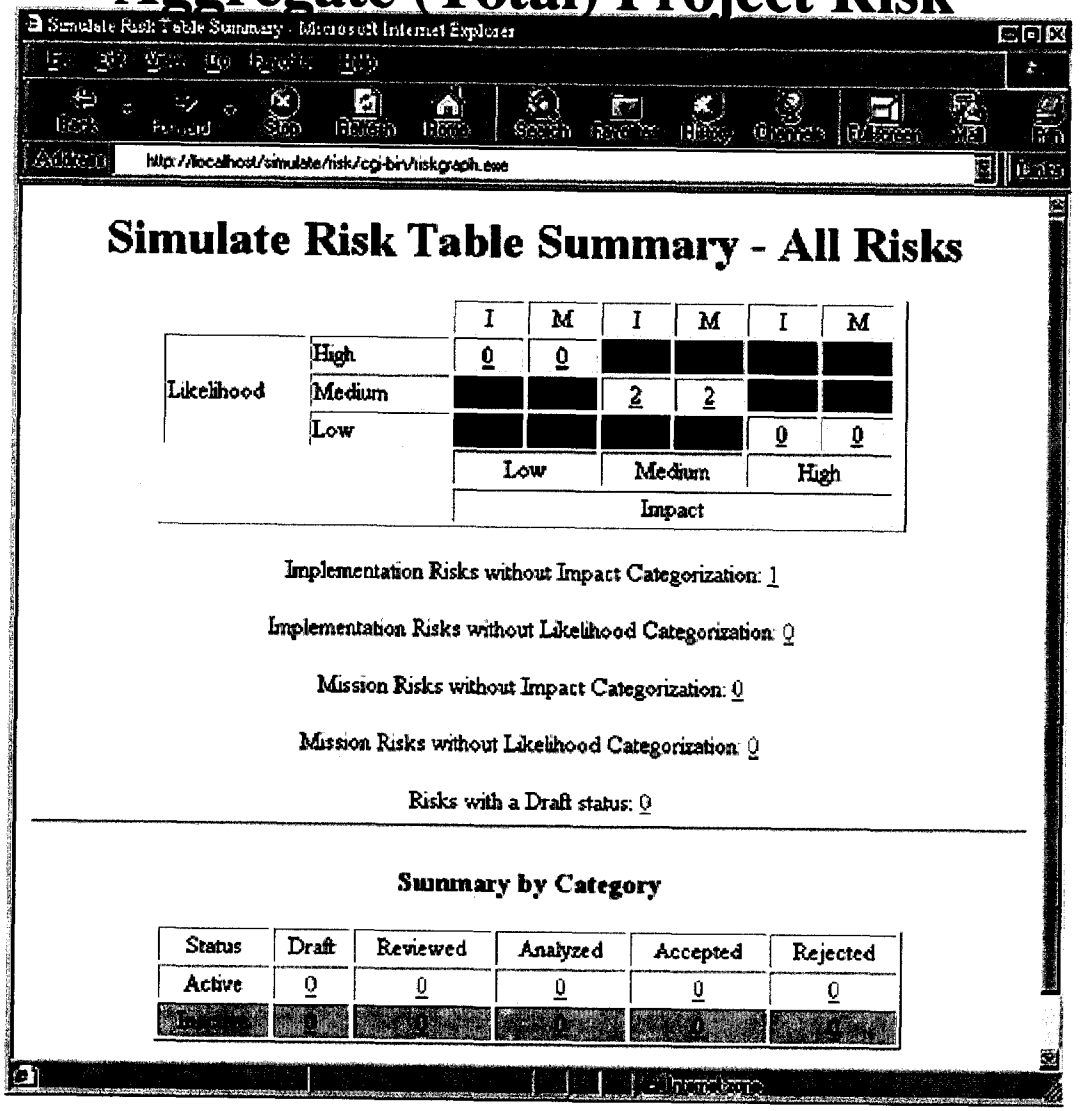
## Web-based Tailorable RM Tool
## Significant Risk List



# *Risk Management on JPL Projects*

## Web-based Tailorable RM Tool

## Aggregate (Total) Project Risk



# *Risk Management on JPL Projects*

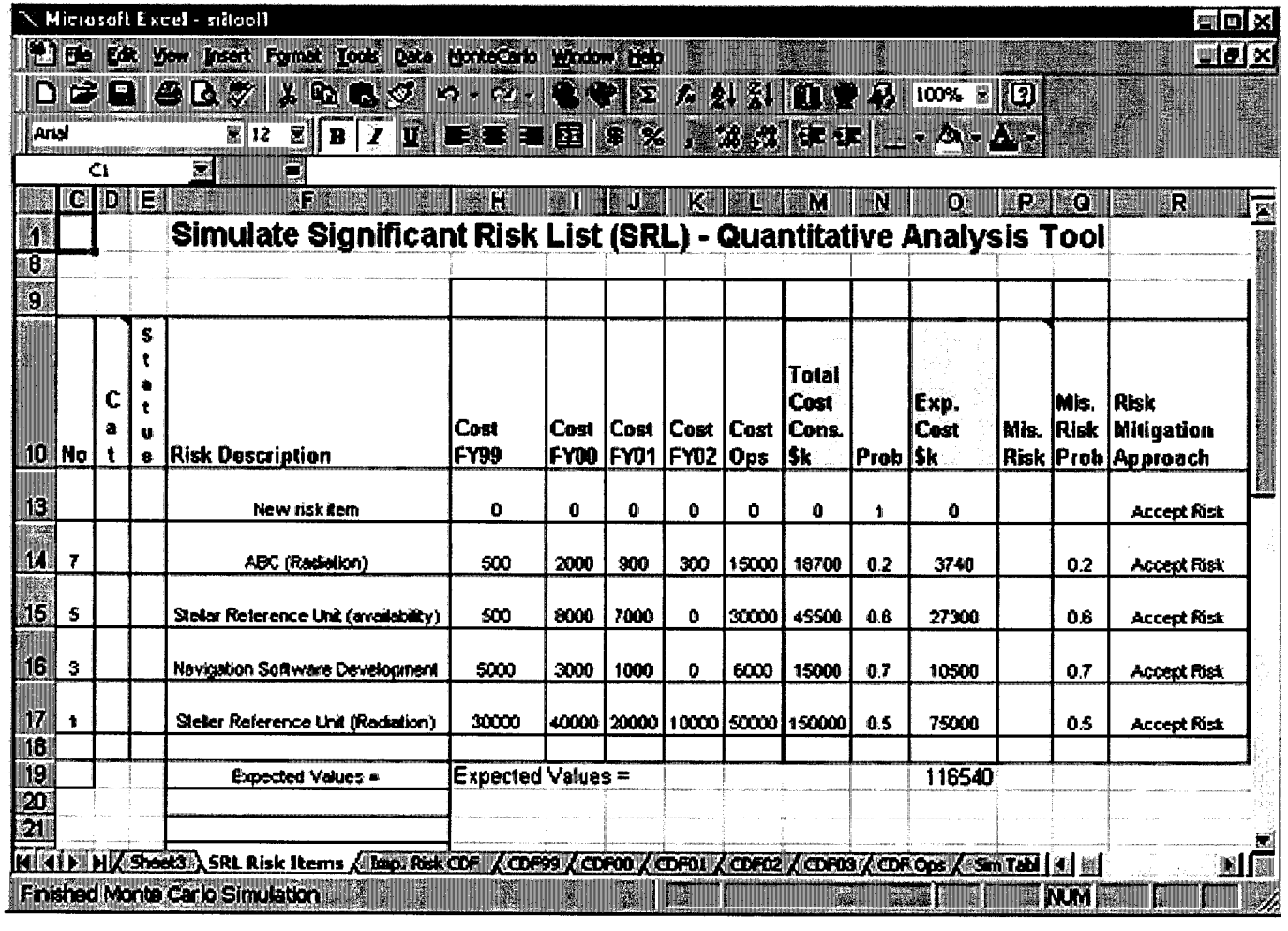
# Tools

## Other Computer Tools

- **EXCEL-based Significant Risk Tool**
  - Allows quantitative assessment of implementation risk on individual risk items, total risk.
  - Monte Carlo routine included.
  - Not multi-user.

# *Risk Management on JPL Projects*

## Web-based Tailorable RM Tool
## SRL Tool Data Sheet



Microsoft Excel - sldool1

File Edit View Insert Format Tools Data MonteCarlo Window Help

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C1

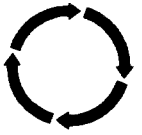
**Simulate Significant Risk List (SRL) - Quantitative Analysis Tool**

| No | Cat | Status | Risk Description | Cost FY99 | Cost FY00 | Cost FY01 | Cost FY02 | Cost Ops | Total Cost Cons. $k | Prob | Exp. Cost $k | Mis. Risk | Mis. Risk Prob | Risk Mitigation Approach |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | New risk item | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | | Accept Risk |
| 7 | | | ABC (Radiation) | 500 | 2000 | 900 | 300 | 15000 | 18700 | 0.2 | 3740 | | 0.2 | Accept Risk |
| 5 | | | Stellar Reference Unit (availability) | 500 | 8000 | 7000 | 0 | 30000 | 45500 | 0.6 | 27300 | | 0.6 | Accept Risk |
| 3 | | | Navigation Software Development | 5000 | 3000 | 1000 | 0 | 6000 | 15000 | 0.7 | 10500 | | 0.7 | Accept Risk |
| 1 | | | Stellar Reference Unit (Radiation) | 30000 | 40000 | 20000 | 10000 | 50000 | 150000 | 0.5 | 75000 | | 0.5 | Accept Risk |
| | | | Expected Values = | Expected Values = | | | | | | | 116540 | | | |

Sheet3 | SRL Risk Items | Imp. Risk CDF | CDF99 | CDF00 | CDF01 | CDF02 | CDF03 | CDF Ops | Sim Tabl

Finished Monte Carlo Simulation NUM

# *Risk Management on JPL Projects*

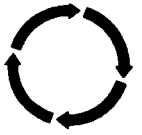


# Tools

## Other Resources

- **Risk Management Home Page**
  - Provides background, reference material, product descriptions
- **RM Handbook (JPL D-15951)**
  - Reference for RM Methodology, Tool descriptions, templates
- **Risk Management Workshop**
  - Available through Professional Development or by appointment
- **Risk Management Team**
  - Available to initiate Project in Risk Management, consult, and otherwise be useful

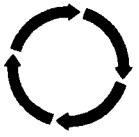
# *Risk Management on JPL Projects*



# Usage on Projects

| **Project** | **Risk Mgmt Plan?** | **Risk List?** | **Data Base Tool?** | **SRL Tool?** |
|---|---|---|---|---|
| SIRTF | yes | yes | developed it | no |
| MGS | yes | yes | preceded tool | developed it |
| Stardust | tailored | tailored | preceded tool | no |
| X-2000 | yes | yes | yes | no |
| Genesis | tailored | tailored | tailored | no |
| Cassini | yes | tailored | preceded tool | preceded tool |
| SRTM | yes | yes | preceded tool | yes |
| SIM | in development | installed | yes | ? |
| DS-4/Champollion | in development | installed | yes | probably? |
| MIRO | draft | in dev | no | similar |
| New Millenium Prgm | in development | ? | ? | ? |
| GALEX | yes | yes | yes | no |
| Mars 2001 | draft | yes | no | similar |

# *Risk Management on JPL Projects*



## Lessons

- **Managing Implementation Risk Effective**
  - Real visibility in usage of budget reserves
  - Requires credible likelihood, cost estimates
  - Encourages future-looking problem anticipation

- **High Expectations Among BFC Projects**
  - Want a good tool.
  - Willing to try out and feed back.

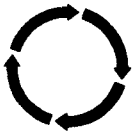
- **Most Projects Comfortable with Adjective Rating Scheme**
  - Not comfortable that numbers are meaningful
  - Can focus management attention on "red" risks(reduce), and "orange" or "yellow" risks (have plans to mitigate/respond)

- **Process Can be Too Complicated**
  - Reluctance to take on expensive-looking activity

- **Don't Know How to Evaluate Mission Risk**
  - Methodology not yet helpful in this area

- **Generally Not the Core Management Tool**
  - Somewhat a sideline activity - not at core of project management

# *Risk Management on JPL Projects*



# Status and Plans

## Risk Management Development

- **Methodology**
  - Developing methods of assessing **Mission Risk** - at risk item and total project level.

  - Developing Concepts for **Program Risk Management**
    - Required in NPG 7120.5A, don't know how to do

- **Integrated Tool**
  - Web-based tool tailorable to approaches selected for each project

  - Develop and prototype a version which will provide $ impact assessments and trade-off results on demand.

  - Initial feasibility version in work.

  - FY99 RTOP planning to support "operational" demo - i.e. demo in a project environment.

  - Supported by NASA Code Q technology development.